

The background of the slide is a blurred image of a particle detector, likely the ECAL, with various components and cables visible. The image is out of focus, creating a sense of depth and complexity.

Vibration Tests for ECAL Mission Success

SERMS @Terni (Italy), Nov./Dec. 2003

Involved Institutions

ECAL Group:

- INFN Pisa
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S. Giurgola
- LAPP
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- MIT
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Hosted by:

- INFN Perugia
R. Batiston, Bruna Bertucci
- Perugia University
L. Di Masso
- SERMS
S. Ascani, D. Cosson, G. Scolieri



Participants



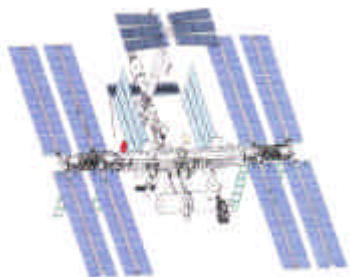
Plan

- Previous tests
- Vibration test at SERMS-Terni
- Accelerometers results
- PMTs results
- Conclusion

Previous Tests

- BISEE (Beijing, China, January 2003):
ECAL Structure
 - > 1st eigen frequency in agreement with FEM
 - > SQ tests of ECAL Structure passed
- ESIA (Annecy, France, February 2003):
Light collecting system + PMT+ EFE
 - > no damage observed for 3 PMTs tested up to
6 g_{RMS}

SERMS at Terni



SERMS

Laboratorio per lo **S**tudio degli
Effetti delle **R**adiazioni sui
Materiali per lo **S**pazio



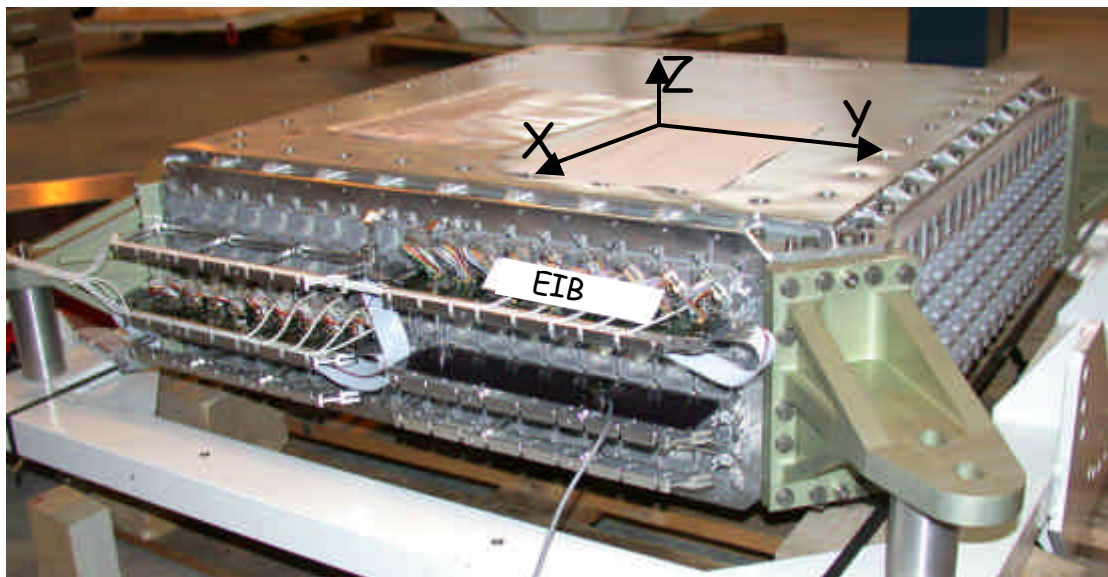
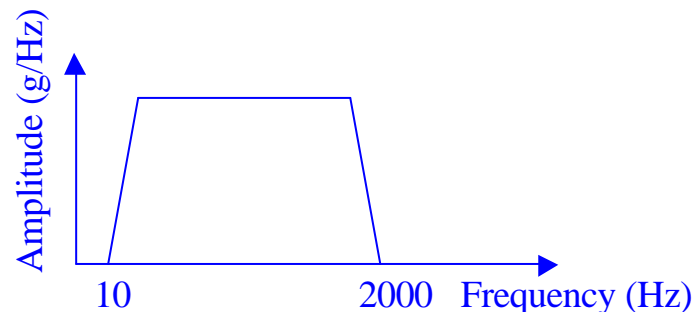
- SERMS shaker capability:
 - up to $3.4 g_{RMS}$ for 2000 kg
 - maximum weight of 950 kg in vertical position
- Under the supervision of Simone Ascani

Goals

X, Y and Z vibrations:

- Sine sweep to check eigen resonances (10Hz-500Hz)
- Random spectrum (10Hz-2000Hz):

X @ 3.1 g_{RMS}
 Y @ 2.3 g_{RMS} (+ Y @ 3.1 g_{RMS})
 Z @ 3.2 g_{RMS}
 (NASA specifications)



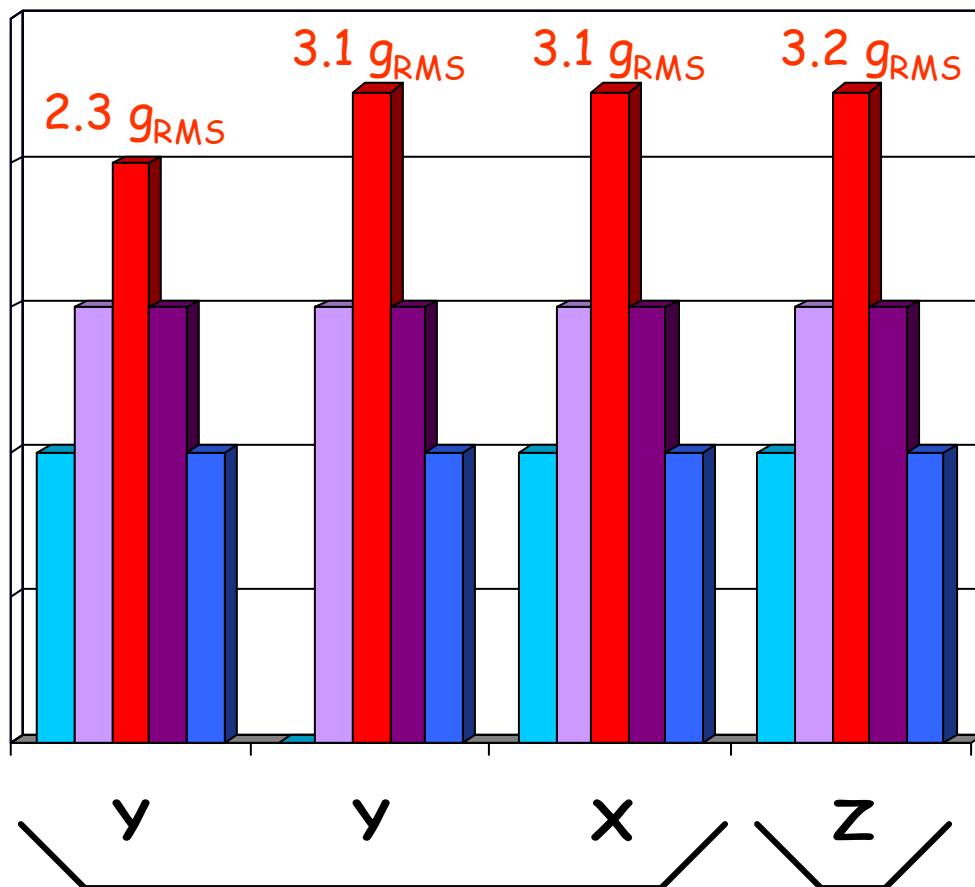
One side of ECAL equipped:
 2 * 5 (PMTs +EFE)
 connected to 2 EIBs

(ECAL fully equipped:
 324 PMTs - 36 EIBs)

LEDs on the side opposite
 to the equipped PMT side

1 radiator covers PMT side

Sequence of the Tests

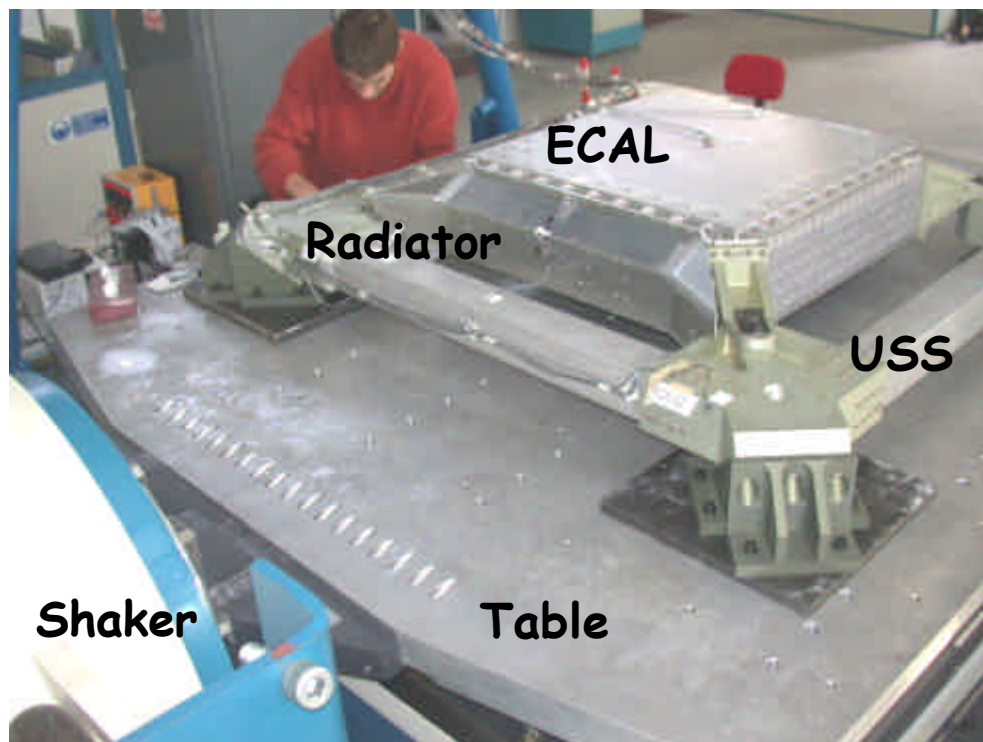


- PMTs Acq. before
- Sine sweep before
- Random
- Sine sweep after
- PMTs Acq. after

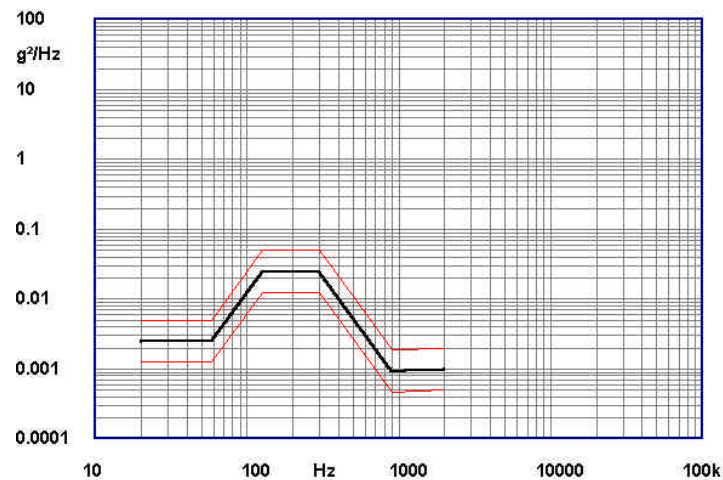
First period:
Nov. 17 - Nov. 21

Second period:
Dec. 3 - Dec 5

X and Y Vibrations



X vibration tests

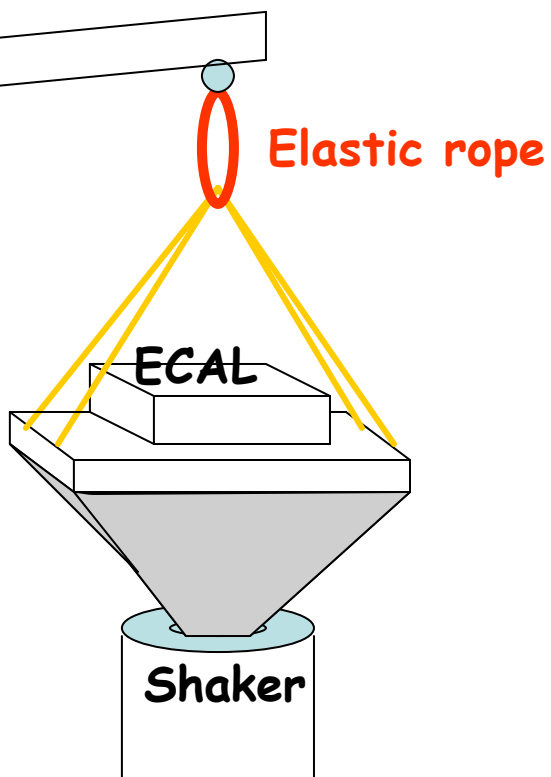


Y vibration tests



Preparation for Z vibrations

Crane



Weight constraints:

Shaker load	< 950 kg
ECAL	= 650 kg
USS-02	= 110 kg
Intermediary supports	= 430 kg (China)
	<u>120 kg (Italy)</u>
	1310 kg

360 kg are removed with the help of a crane + an elastic rope.

Preparation for Z vibrations

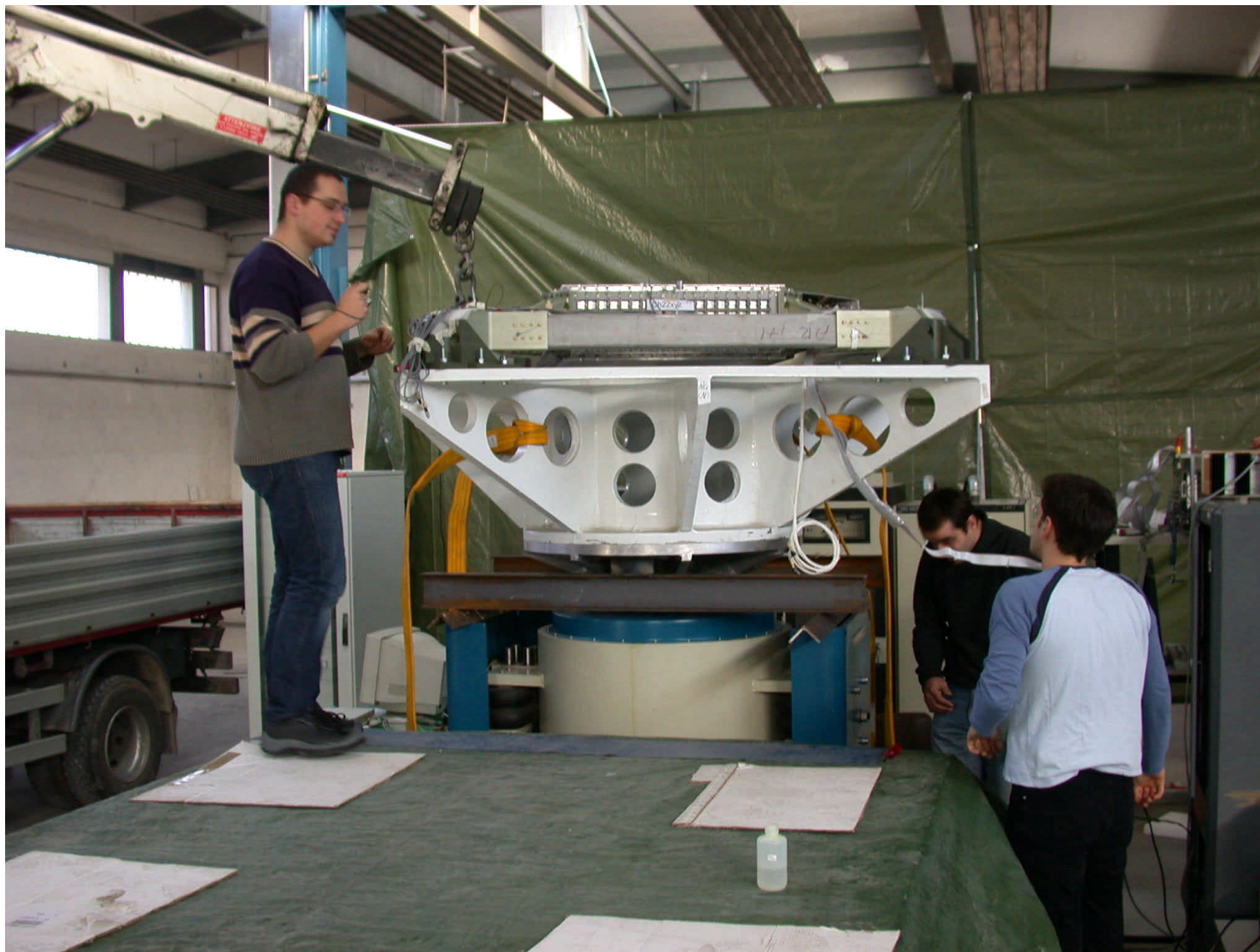


10 days delay!

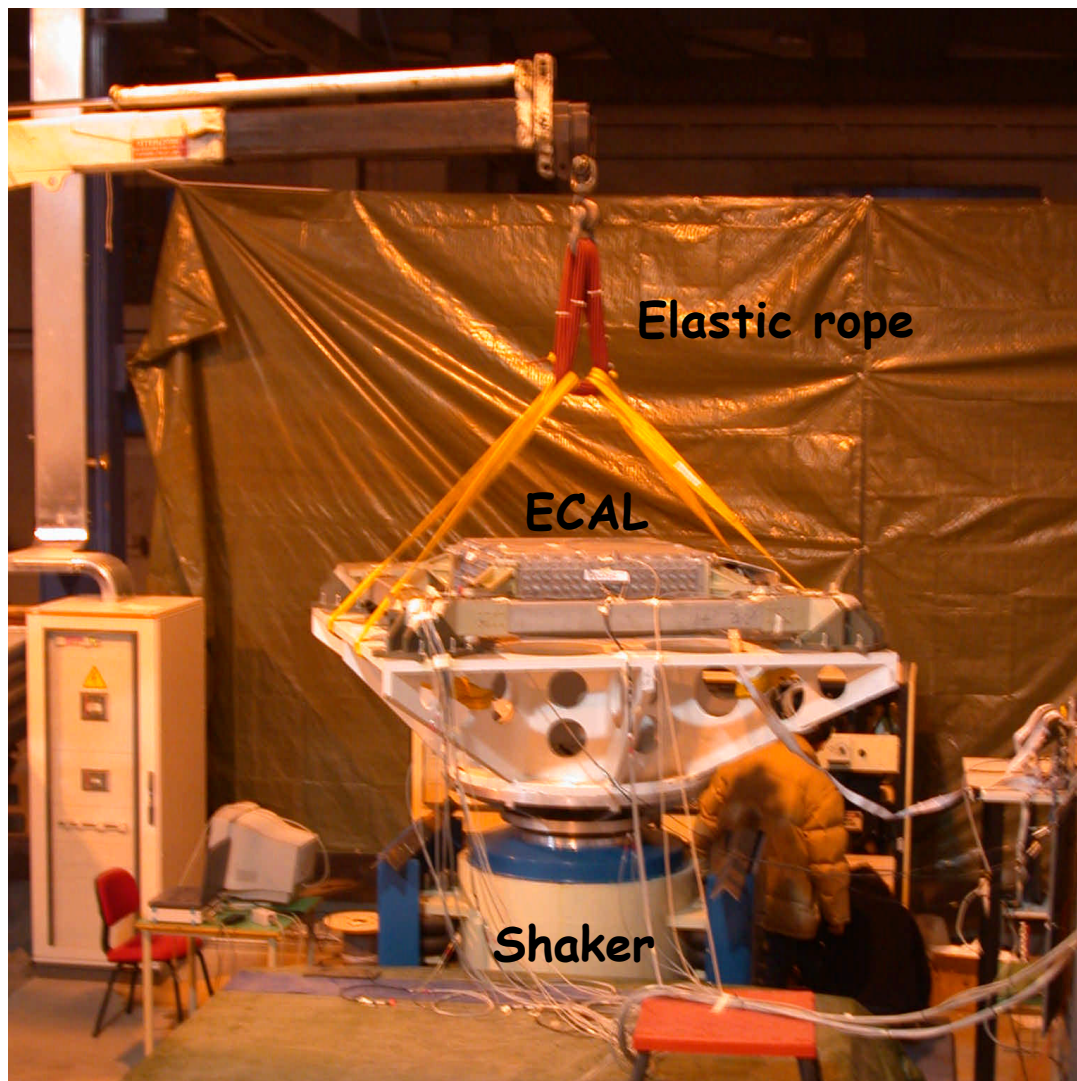
Z vibrations



Z Vibrations



Z vibrations



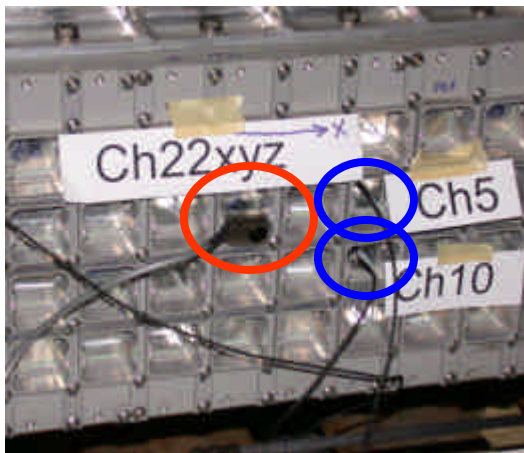
Accelerometers installed

quantity	situation	type
3	Back panel	triaxial
1	EIB	triaxial
1	Honeycomb	triaxial
2	Radiator	triaxial
4	USS-02	standard
6	Honeycomb	miniature

Control

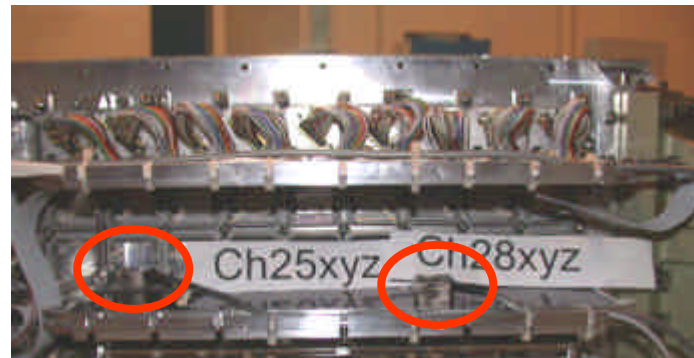
Accelerometers installed

22-23-24

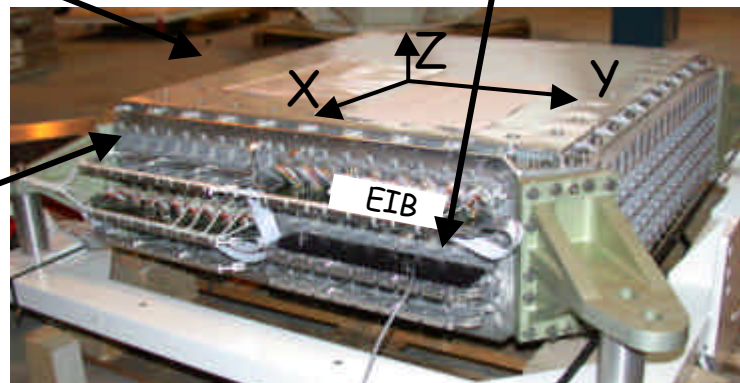
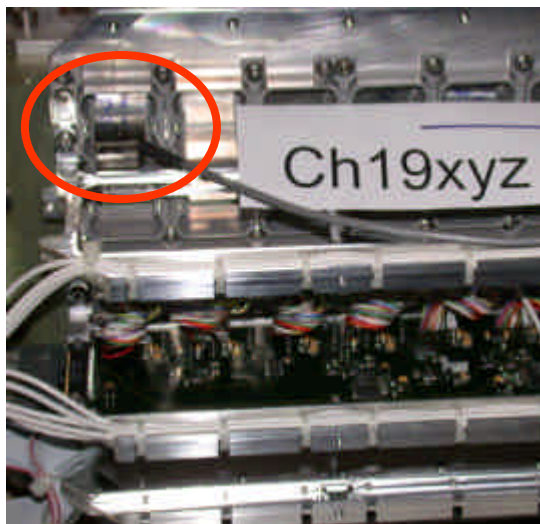


25-26-27

28-29-30

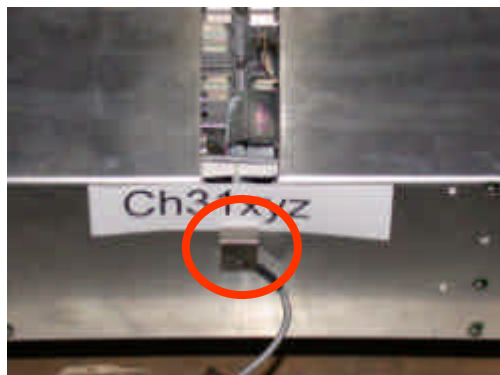
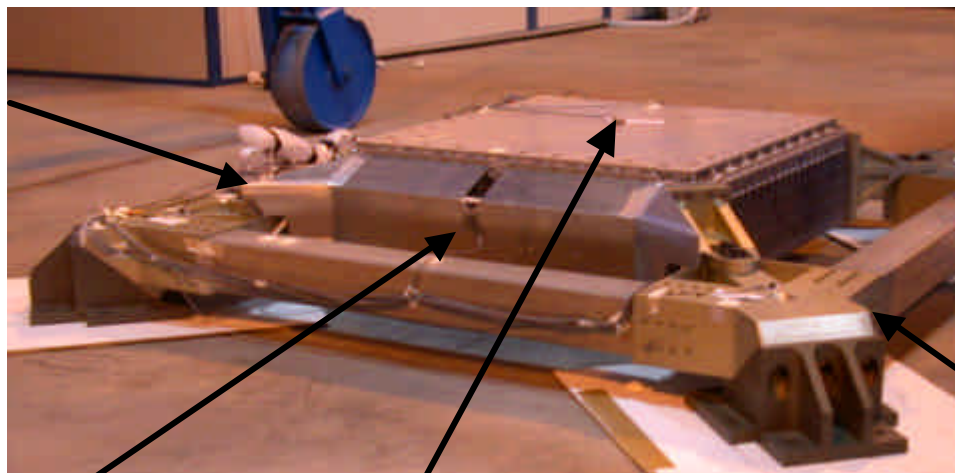


19-20-21



Accelerometers installed

34-35-36



31-32-33



13-14-15



Control

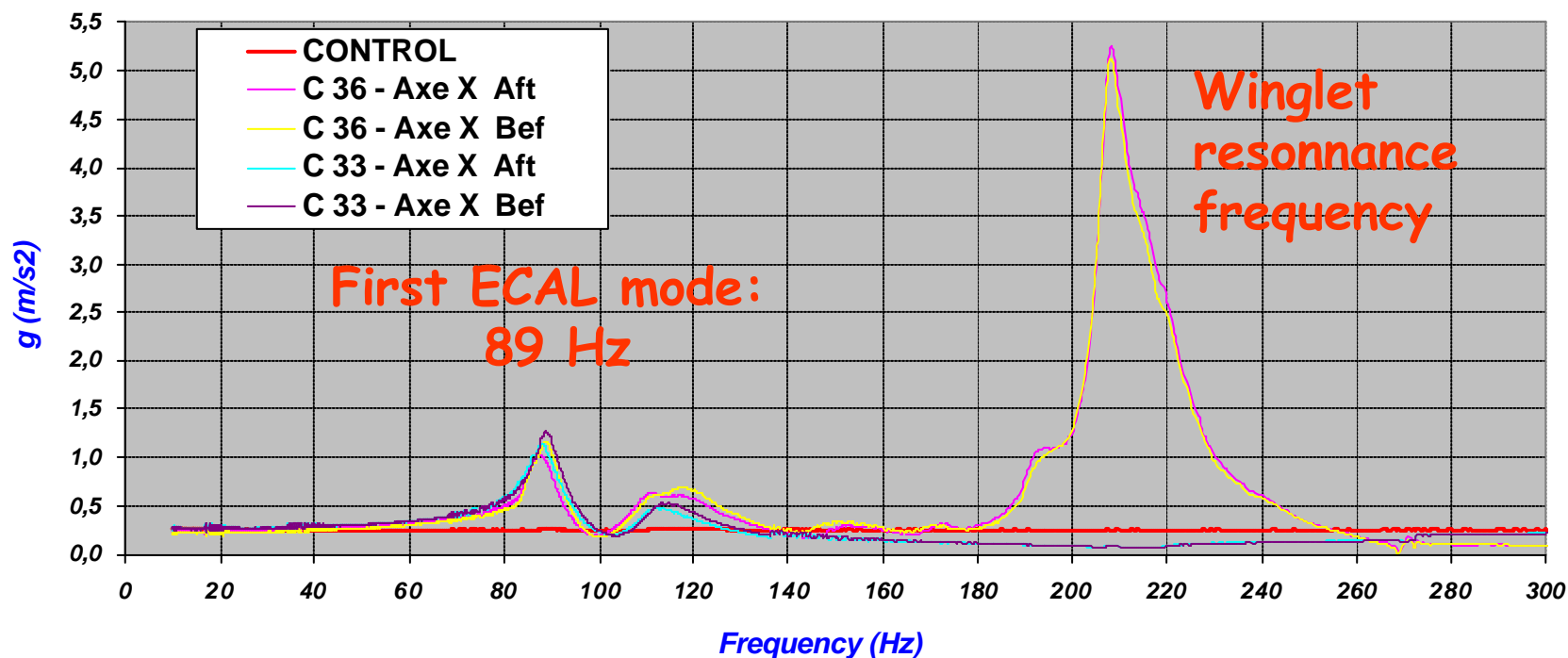
X and Y Vibrations

X axis studies (Before and after "Random")

- Radiator winglets and radiator centre -

C 36

C 33



X and Y Vibrations

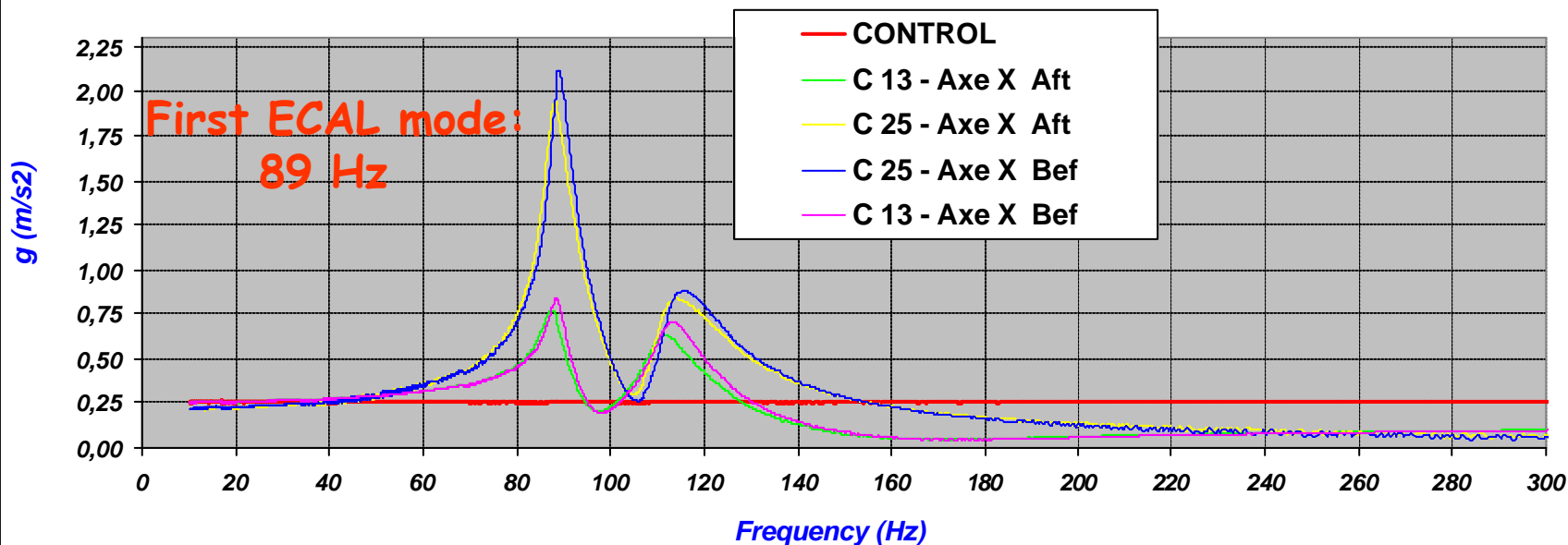
X axis studies (Before and after "Random")

- Honeycomb and back panel centres -

C 13

C 25

First ECAL mode:
89 Hz



Z vibrations

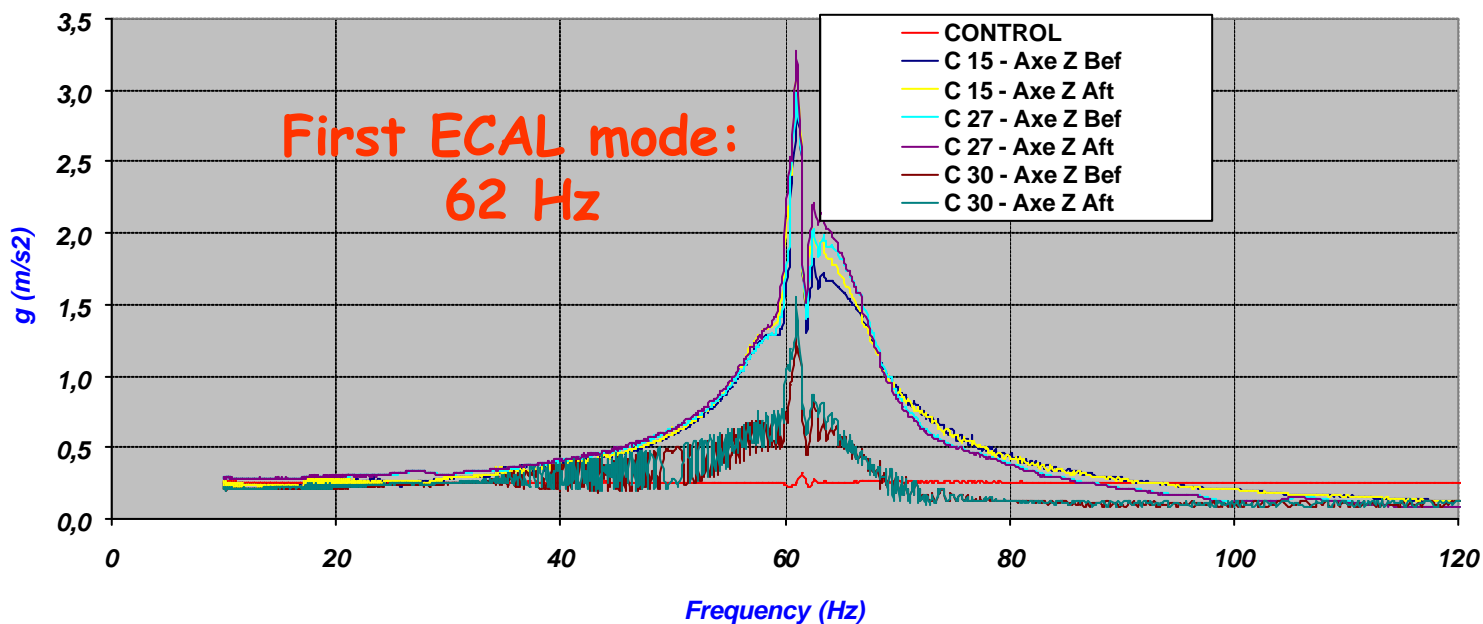
Z axis studies (Before and After "Random")

- Honeycomb + back panel centre + EIB card centre -

C 15

C 27

C 30



Accelerometers study

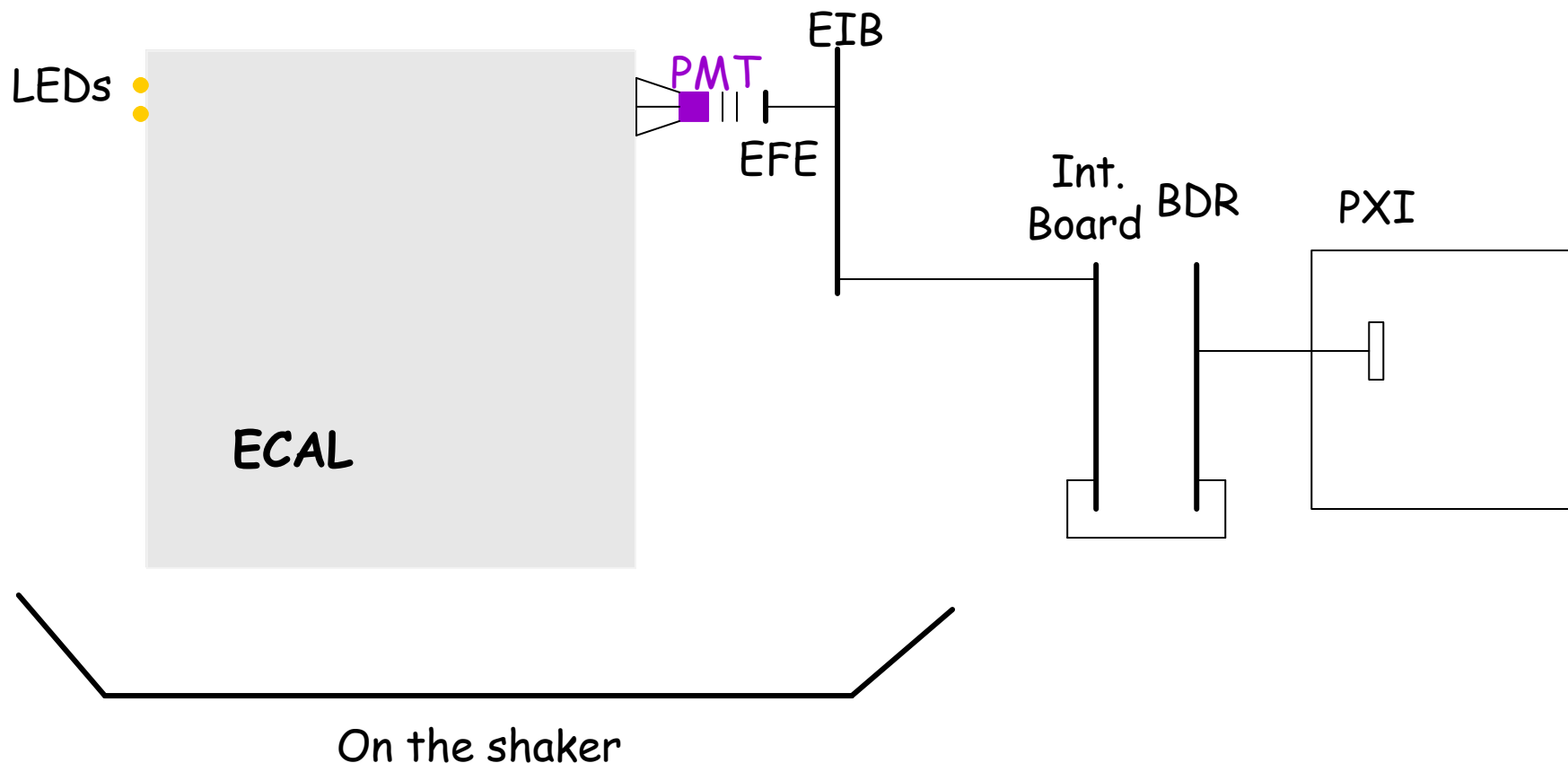
From sine sweep vibration tests:

- no change of eigen resonances after random
 - 1^{rst} mode for X-Y vibration: 89 Hz
 - 1^{rst} mode for Z vibration: 62 Hz
- > confirm China vibration tests

At end of all test:

Bolt torsion moment checked: **ok**

PMT acquisition



The overall reproducibility of the system better than 10%

PMT acquisition

- PMT HV @ 680 V
- several amplitudes for LED signals
- Provisional readout:
 - Intermediate board specially built to match EIB with BDR
 - BDR board



For Z vibrations: upgrade of power supply distribution

PMT acquisition

- ECAL equipped with 10 PMTs
 - > 40 anode signals
 - 10 dynode signals
- 10 acquisitions for each PMT
- Each acquisition:
 - 11 steps of light intensity (30 evts/step)

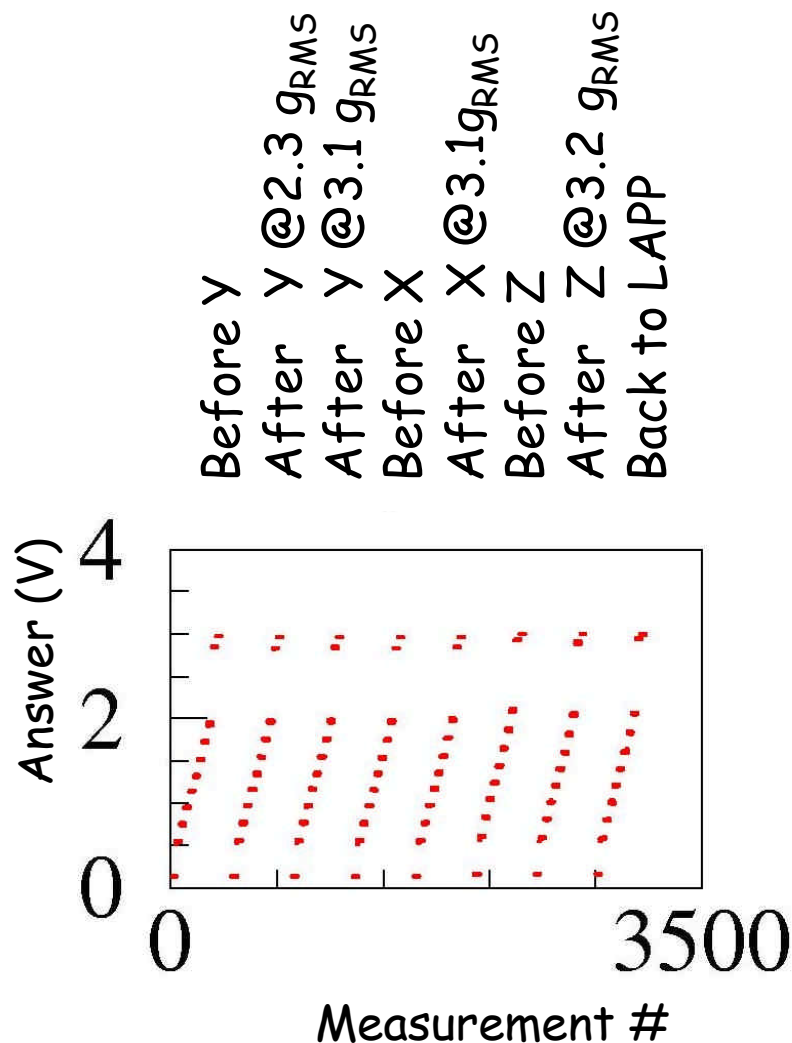
Results

For all PMTs:

Pedestals are stable

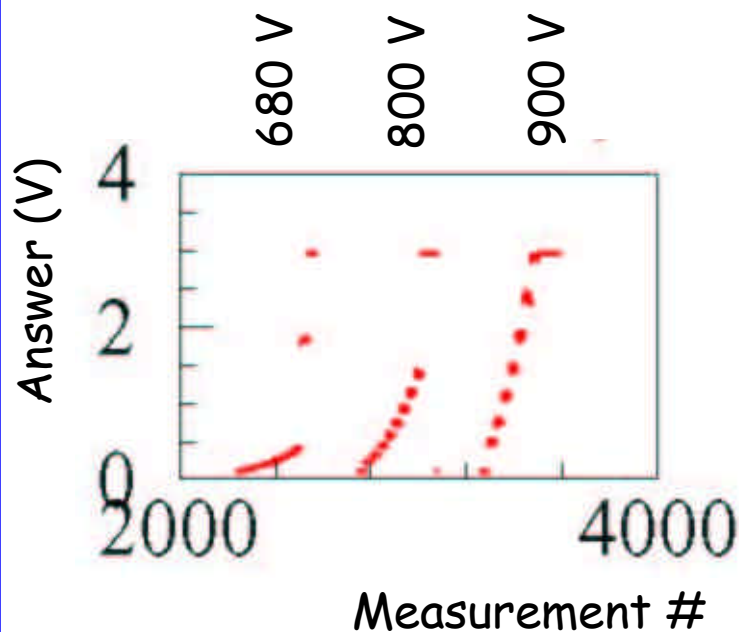
No change in the answer to the LED light within 5 to 10 %.

Example: PMT 9- Anode 4 gain 1

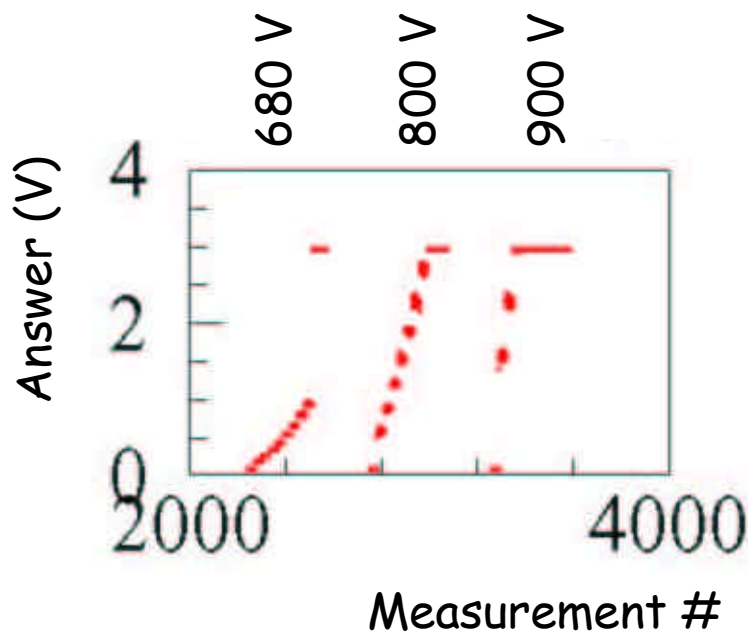


Checks back to LAPP

- Standard acquisition (see previous slide): **ok**
- All PMT HV up to 900 V (PMT specified max. HV): **ok**



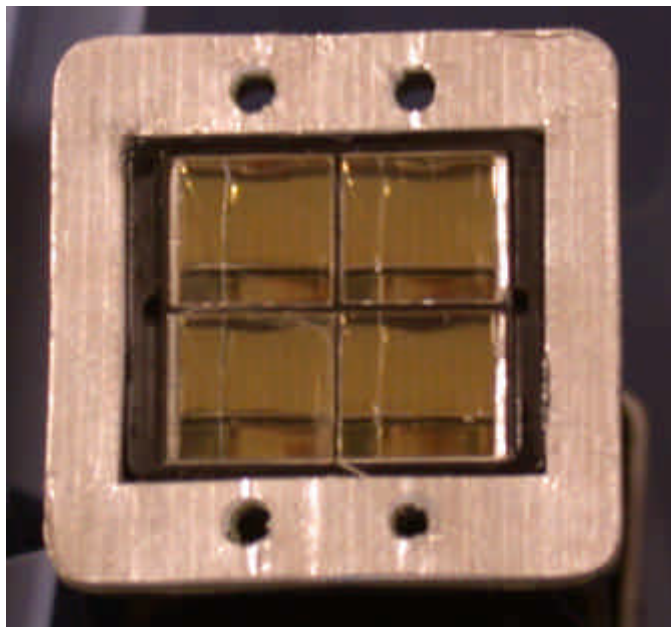
PMT 5 Annode 2 gain 1



PMT 6 Annode 2 gain 1

Checks back to LAPP

- Block PMTs dismounted:
 - check optical couplers from scratches: **ok**
 - check light cones: **ok**



Conclusion

Vibration tests of ECAL + PMTs successfully completed at SERMS - Terni.

- > measurements confirm 1st modes found during China vibration tests
- > No damage for light collecting systems, PMTs, electronics (B1,B2,EFE,EIB)

This validates the vibration part of the ECAL mission success tests.